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by

Choun-Moa Kung

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By: Choun-Moa Kung

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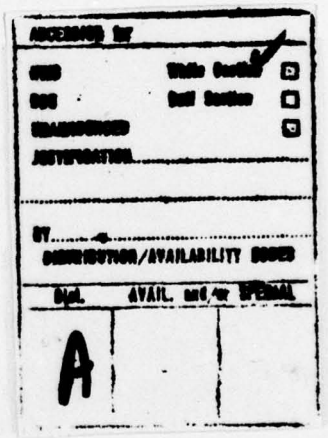

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

SCIENTIFIC AND TECHNOLOGICAL RESEARCH IN CHINA

Choun-Moa Kung

SUMMARY

As scientific competition between the Western and Communist worlds is becoming ever more drastic, Western countries are devoting a great deal of attention to technological progress not only in the Soviet Union, but in China as well. This can be indicated by the systematic study of the scientific and technological development in China by the American National Science Foundation. The purpose of this study is to provide some clues for further study of the science and technology in China. The systems and organizations of Scientific and technological research, budget and political interference, the effect of Cultural Revolution, scientific and technological manpower, aid from Soviet Union, Science & technology and national defense are discussed in this study.

(I) The Systems and Organizations of Scientific and Technological Research.

Before the Cultural Revolution, the research system of science and technology in China was composed of six divisions : the State Scientific and Technical Commission; the Scientific and Technical Commission in each province, autonomous region and special municipality which is under the direct jurisdiction of the Central government; China Institute of Science (CIS); advanced educational institutes; the scientific research departments in state-owned enterprises and local research insti-

special municipality which is under the direct jurisdiction of the Central government; China Institute of Science (CIS); advanced educational institutes; the scientific research departments in state-owned enterprises and local research institutes. The responsibilities and functions of these 6 divisions have been defined in 1956, as listed below :

A. State Scientific and Technical Commission : Its main responsibilities are :

1. Supervise the implementation of 12-year scientific and technical plans, especially in several major fields (total : 57).
2. Coordinate the annual and long-term plans of each research institute into a national plan.
3. Coordinate between divisions in the whole system.
4. Manage the scientific fund for research plan in major fields.
5. Plan for the training, arrangement and employment of the experts.
6. Supply the environment for scientific research, e.g., library, information service, equipment and chemical reagents, etc.
7. Arrange the international cooperation in science and technology.

These responsibilities were defined before the reformation of the Scitific Planning Commission which combined with National Technical Commission to form State Scientific and Technical

Commission in 1958. The new commission takes more responsibilities.

B. The Scientific and Technical Commission in each province, autonomous region and special municipality. Its responsibilities are :

1. Supervise the implementation of the local plan which is part of national future and annual plans. Help Central government supervise the local research institute.
2. According to the local need and potential, set up a local plan which is not listed in the national plan.
3. Coordinate the related divisions when necessary.
4. Solve the problems in scientific working environment and serve the people for their need.

Most of the province, autonomous region and special municipality already set up local Scientific and Technical Commissions. Some areas, including Shien and special region, also have organized Scientific and Technical Commissions.

C. China Institute of Science.

The China Institute of Science is the leader of science and technology in China and has devoted to research works in several major fields. Its direction for development is set on the basic researches of theoretical study in the major fields of science, the modern technology required by "national establishment" and the general scientific problems in national economy. Meanwhile, the academic activities happening in the whole world and China have to be

closely watched in order to lead the scientific and technological research in China. Special attention should be paid to the new direction in each individual field.

Before the Cultural Revolution, China Institute of Science was composed of 5 departments: (1)Department of Physics, Chemistry and Mathematics (2) Department of Biology (3) Department of Geology (4) Department of Technology (5) Department of Philosophy and Social Science. Two hundred and thirty-three members are employed by the Institute to supervise more than one hundred research oganizations (mainly research institutes and independent laboratories).

D. Advanced educational institutes

China has emphasized that the scientific researches in advanced educational institutes have to be promoted and strengthened. Both the basic scientific subjects and the engineering problems raised from practical production should be evenly explored. Each school has to set up a solid plan based on individual circumstance in order to become the center (or one of the centers) of national scientific research in one specific (or several) field.

E. The scientific research system in state-owned enterprise:

The scientific research system in state-owned enterprise is composed of the research institutes from each individual department. China has emphasized that the scientific research in each state-owned enterprise has to be strengthened, therefore, they

can work together to solve more specific problems, apply these results to practical production and induct new scientific theories from the production experience. It has also been pointed out that each state-owned enterprise should set up necessary research institute which is under direct control of the government. Above all, more attention has to be devoted to the central laboratory in mining factory. The purpose is to help enterprise-owned research institute become the nation-wide research center in specific fields. State-owned enterprises include Department of Education, Department of Geology, Department of Agriculture, Department of Metallurgical Engineering, Department of Mining, Department of Defense, and Department of Mechanical Engineering, etc. It has to be pointed out that China Institute of Agriculture (formed in August 1957, CIA) and China Institute of Medicine (CIM, formed after CIA), which are ranked equally with CIS, are not under direct control of Dept. of Agriculture and Health. However, their researches are under the direction of Agriculture and Health Department. This is the reason why these two institutes are included in this category.

F. Local scientific research system :

This system is composed of the local branches of CIS, CIA and CIM, and other scientific research organizations. It has been indicated that local institute should set up a complete, step-by-step research plan based on the local demands and carry it out through cooperation with the facilities and manpower at hand.

The total number of research institutes in China varies every year due to the establishment of new institutes, and shut-down and combination of old institutes. In 1963, there were totally 805 research institutes (or laboratories) : 305 of Biology, 205 of Physics and 271 of Engineering.

There are —> many associations of Science and technology, which function as media of scientific communication. According to the statistics in 1962, there were about 40 associations of science and technology and 100,000 members in these associations. Most of the associations are under control of Division of Scientific Education formed by Central Committee of Communist Party. The informations of scientific development in foreign countries are collected by Communist oversea bookstores, Scientific & Technical Information Service in CIS and National Peking Library. The publications of these informations are distributed by the above organizations with the assistance of Hsien-Hwa Bookstore.

China obtained a great deal of scientific informations by exchange. In 1961, China imported 110,000 books and exported 135,000 books. Most of them were exchanged with the Soviet Union. CIS already obtained 572 kinds of journals from Soviet Union before the rift in Sino-Soviet relations in 1960. It is believed that China has spent 1,800,000 pounds in buying books and journals from foreign countries in 1956, and 1,500,000 pounds in 1957.

China has started to obtain books in science and technology from Western countries and Japan since 1960. Most of them were

translated into Chinese and published. The publication is affected by political movement. For example, after the failure of "Great Leap Forward", the scientific publication had been banned for 5 years. In 1966, beginning of the Cultural Revolution, the priority of publishing "Little Red Book" caused the decreased publication of other books, including scientific books.

(II) Scientific and Technical Manpower

There is not too much information about the scientific and technical manpower in China. However, a reasonable estimation of scientifically-trained population before 1967 can be made. There were 2,000,000 college graduates till 1967. One third of them, about 650,000, obtained engineering training, 125,000 obtained scientific training, and 85,000 were trained in Natural Scinece.

If we compare this figure with that of 1949 : In 1949, 17% of the college students obtained training in engineering, 8.5% in Natural science and 7% in Agricultural Science. Right now, the population of Agricultural Science is only 8% of the trained staff, which seems to be a big mistake since they ignore the training of agricultural experts as they advocate agricultural development.

China still maintains a scientific and technical staff of 4,500 members who have been trained in Japan, West Europe and the United States. Among them, 1,000 members have obtained Ph. D. degrees. According to Russia's information (till 1960), China had sent

1,300 scientific and technical staff, 1,200 college instructors, 2,000 graduate students and 7,500 college students to Soviet Union for study. The rift in Sino-Soviet relations ended the program. The last group of 65 Chinese students were sent back to China in 1966. Generally speaking,in China, there are about 10.000 to 12,000 persons who have obtained advanced degrees, of which ¼ are in science and technology.

For the past 20 years, the quality of domestically-trained scientific staff has been questionable. Some of them were indeed well trained, nevertheless, many of them only took intensified courses and highly-specified training. Even China itself admits that its college instructors are usually lack of good training, In particular, the contradictory situation between"Politics" and "specialty" forces college to put more emphasis on politics than the course requirements.

Although the training of engineer is claimed to be multi-directional in China, they overemphasize the training in mechanical engineering and architecture. One third of the scientific staff were forced to take biological training, and rest of them are all in Natural Science.

Not only the quality of scientific staff is very poor, China is also short of experienced scientists to direct a plan for research development. The best scientists are all assigned to the fields of nuclear engineering and missile system. In a developing country, who mostly copies the foreign technology, it needs more generally-trained ~~scinetists~~ scientists to help the national economy develop, rather than the engineers in missile and nuclear

system. The way China handles it seems to be abnormal.

(III) Budget and Political Interference

All the evidences indicate the rapid increase of scientific budgets in China. According to an incomplete statistics about the budget of China Institute of Science, it increased from 3,237,000 dollars (Chinese Currency) in 1950, to 3,350,000 in 1953, then to 6,674,000 in 1956. The scientific budget in 1951 was estimated only about 0.1% of the national budget, but increased to 4.7% in 1965. However, this figure is still trifling compared to United States and Soviet Union. The reasons China can initiate the scientific development plan with lower budget (compared to highly-developed countries) are :

1. Low salary for scientific and technical staff.
2. Most of the scientific development plans copy foreign technology, therefore, the budget for basic research development can be largely cut down.

In spite of the emphasis on technological research development, China stresses more on " Red and Speciality" and "Priority of Mao's Thought", which inevitably impedes the development of technology and science. For example, the Cultural Revolution caused a serious and extensive disturbance to scientific and technical development. Many evidences have indicated that the researches in CIS and many other institutes belonged to different ministries, were once interrupted, facilities were damaged and every research plan was suspended. Only the nuclear weapon research units were not affected.

During the Cultural Revolution, all the colleges and some high schools were shut down. The colleges and universities were not reopened until 1970 school year. The requirement for admission to colleges are "class constituent" and "political consciousness". Therefore, most of the colge students are farmers and low-class workers, who have practical working experience, but poor scientific background. This situation causes problems in teaching.

The problems in educational system will cause seriously detrimental effect on Scientific and technological development. For example, Cultural Revolution interrupted the training of scientific and technical manpower,which caused the decrease of scientific population. The admission of scientific students had been based on the entrance examination in the past, which was cancelled in the Cultural Revolution, Under this circumstances, the quality of science and technology-majored students can not possibly be improved.

(IV) Aid from Soviet Uninn

In order to understand completely the scientific and technological development in China, we must look back at the assistance which Soviet Union offered to China.

By 1960, Soviet aid played an important ~~rale~~ role in all scientific areas. Thousands of Soviet scientists, engineers, professors and technicians helped plan, organize and initiate the

Chinese educational system and scientific development plan. Soviet Union also supplied hundreds of complete sets of factory facilities in order to help develop heavy industry. Thousands of laboratories in educational and research institutes were also furnished with all kinds of modern equipment made in Soviet Union.

In addition, Russia also supplied a 7 megawatt reactor, two small research reactors, a proton accelerator and other special equipment and materials. They also gave special training in nuclear engineering to Chinese technicians. Outsiders all believe that Soviet engineers help China construct some of the U^{235} purification factories in Nan-Chow. China obtained the technique to manufacture fussion and fission weapons due to this cooperation. On Oct. 15, 1957, eleven days after the launch of Sputnik satellites and seven weeks after the announcement of the test of intercontinental ballistic missiles in Soviet Union, a decisive agreement was made secretely between Soviet Union and China about national defensive technique. According to this agreement, Soviet Union would offer China a sample of nuclear bomb and detailed information of manufacturing technique. In Nov. 1957, Mao, with high military officers, attended a meeting in Moscow and held a long talk with Soviet Premier. It might be possible for China to get the informations of missile manufacturing technique in this visit. Russia also supplied navy vessels, including Diesel

engine submarines, all kinds of rockets and military electronic devices.

The role that Soviet Union was playing did not end with the sudden departure of Russian experts from China in summer of 1960. The Soviet influence still existed even after the rift in Sino-Soviet relations. For example, the MIG 21, which China started to manufacture in 1965, and the nuclear submarine which they are trying to manufacture, are both imitations of the Soviet weapons. Since 1965, China has launched two satellites and held 14 nuclear bomb tests, which mostly used Soviet designs as blueprints. In particular, the design of the satellite launch vehicles was based on the medium range ballistic missiles, which further verifies that China satellites plan are based on the medium range rockets and missile techniques offered by Soviet Union.

(V) Technology and National Defense

China puts the most attention to Electronic Engineering among all the defensive technology, sinee Electronics is an indispensable part of automation, radar system, television, calculator, satellites, guided missiles, communication and navigation. They declared that the number of electronic factories and workshops in 1970 is 2.5 times larger than that which existed in 1969 and 20 times greater than the figure in 1965. It is believed that there are 100 factories in Shanghai mainly manufacturing electronic components and products. The number of electronic factories in Peking also doubled in the meantime.

There are 320 electronic factories and workshops in production in Liaoning Province now. According to the report in Peking Weekly News, Jan. 1, 1970, the annual major electronic production in 1969 broke the highest previous record in the past few years.

According to foreign reports, China now can produce the electronic products listed below : 5-digit calculator, electrostatic accelerator (These two are necessities for nuclear development), 400,000 X electromicroscope (manufactured in Shanhai), high-voltage transformer, semiconductor, magnetometer, potentiometer, electronic tube, silicon rectifier, transistor, electromechanical devices, and high performance electronic components.

The shipbuilding responsible by Department of Mechanical Engineering VI also makes some achievements. It is believed that 9 vessels over 10,000 tons were built during 1967-1970. The launch of 15,000 ton tanker, Da-Chin 27, on Feb. 1, 1969 proves that CHina is already familiar with the technique of tanker-building.

Information from Japan has indicated that G-type nuclear power submarines with 3 sets of missile launching tubes are under construction in DaLing and Shanghai shipyards.

New York Times reported on May 31, 1971, that a shipbuilding yard close to KwangChow was trying to rebuild a 12,000 ton freighter in order to put on the radar and tracing devices. They also reported that China had built a launching station in Manchuria and launched a multi-stage rocket to Turkestan which is 2,200 miles away from the station. According to the estimation, this rocket can travel at least 3,500 miles

to the Indian Ocean.

Another statement was made in the same issue that China was building a F-9 two-engine jet bomber based on MIG-19. It is believed that they have already manufactured 60-70 bombers which can attain Mach 2 with a combat radius of 300-500 miles.

(VI) Conclusion

(1) China has put a great deal of effort on the improvement and propagation of science and technology. However, they overemphasize the research of applied science and relatively ignore the basic theoretical research. They also emphasize "group" research and disencourage "individual" research. In spite of the extensive research activities in each organizations, most of them are military and propaganda-oriented, e.g., the building of space craft and satellites. Therefore, research in biological science is ignored and researches in agriculture are suprisingly scarce.

(2) The quantity of scientists is very limited in China, therefore, they have to restrict the best scientists and materials to the development of certain fields. The development of nuclear weapons can be a good example. Meanwhile, their technological development depends mostly on copying foreign techniques, which they learn from publications or products made by other countries. They seldom exchange scientists or technicians with other countries.

(3) There is a shortage of scientists, especially the experienced scientists who can plan and direct the research development. Although the scientists in China can obtain the related informations from foreign publications, they cannot contact directly with the scientists in highly-developed countries.

(4) An obstacle of research development is formed due to the poor communication between each institute caused by the overemphasis of secret service. However, according to their system, all the researches can be planned as a whole and fairly assigned to each institute, which seems to be beneficial.

(5) Generally speaking, the direct assistance from Soviet Union seems to be impossible in the future unless their relations can be improved. On the other hand, the foreign-trained scientists and technicians, who have been the core of scientific and technical development are either too old or dead, which cause the problem of succession. Therefore, the future development has to depend on the domestically-trained scientists, who have suffered the educational modifications during the Cultural Revolution. It is really questionable whether these scientists can lead the scientific and technological development or not. China wants to catch up with the highly-developed countries, but, they still have a long way to go.

(6) China has made some achievements in the past 20 years, e.g., nuclear bomb tests and launches of satellites, but their technology is still weak. The political pressure, trial modifications

of the educational system, and the supervision of technology development plan by military cause more problems in its scientific and technological development.

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